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Semi-annihilating scalar dark matter

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Scalar dark matter models invariant under a discrete Z_3 or Z_4 symmetry are studied. Unlike in the usual Z_2 case, their phenomenology can contain semi-annihilations – processes in which two dark sector particles scatter into a dark sector and a SM particle. The simplest such model has complex scalar singlet DM stabilised by Z_3. Compared to the well-known Z_2 case, the new processes can significantly change relic abundance and prospects for direct detection. The requirement that Z_3 be not broken spontaneously, however, places a lower bound on the direct detection cross section and will allow the whole parameter space to be tested by XENON1T. Addition of new scalars can stabilise the Higgs potential up to the GUT scale. In case of the Z_4 symmetry the minimal model with semi-annihilation contains an inert doublet in addition to the singlet, and dark matter can be two-component.

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